COUPLING OF REPETITIVE MULTIBEAM SURVEYS AND HYDRODYNAMIC MODELLING TO UNDERSTAND BEDFORM MIGRATION AND DELTA EVOLUTION

Abstract

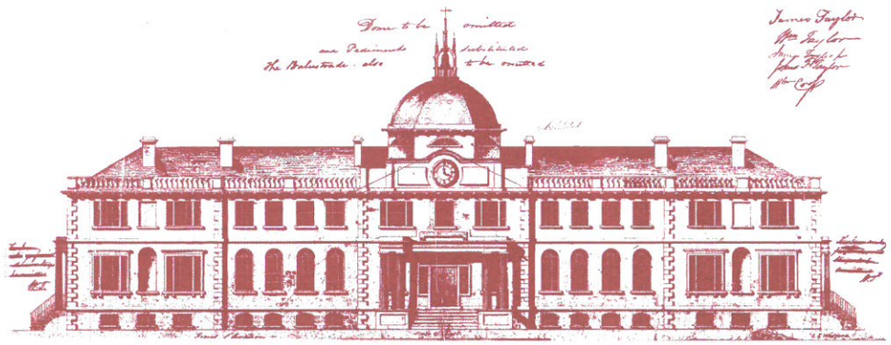
The present study is complementary to a parallel project looking at the sediment migrating on the delta slope as landslides or turbidity currents. This study addresses channelized delta top sediment transport on the Squamish estuary in Howe Sound, British Columbia. The mechanism of bedform migration and delta evolution is affected by the manner in which the available sediment flux from the feeder fluvial system is distributed.

The termination of the Squamish River consists of a single channel that flows between flanking intertidal sand bars and over a mouth bar at the lip of the delta. The delta front is growing rapidly with about 1 million m^3 of sediment being input from the river system annually. There is a 3.0 to 5.0 m tidal range that strongly modulates the flow in the channel and over the adjacent intertidal sand banks. The channel depth at low water ranges from -0.5 to 2.0 m (a positive depth is downward from Chart Datum) and thus multibeam surveys can only be carried out at high water.

In 2011, the delta top channel was surveyed every 3 to 4 day at high water, over a period of 4 months during which the river discharge waxed and waned and the tides ranged from springs to neaps. In 2012 and again in 2013, the channel was surveyed daily over a week while the tides increased from neaps to springs.

While the long wavelength shape changes over a time scale of about one week, it is clear that the individual bedforms cannot be correlated from one tide to the next, indicating much faster evolution. In order to understand the sediment transport mechanism in this estuary, this research parameterized the short wavelength bedform morphology and the long wavelength channel shape on the delta top, extracted the shape of the delta lip, and used volumetric characterization of the sediment on the delta top and the delta lip vicinity. A three dimensional hydrodynamic model was also built to predict the flow within the river, the delta top, and adjacent fjord over the complete tidal cycle so that the bed shear stress associated with tide modulation and river discharge could be quantify.

This research shows that the short wavelength bedform characteristics and long wavelength channel shape are primarily a result of the low water period when the off-delta flows are strongest. The flow fields of the research area are dominated by the tidal modulation. However the river surge also plays a role during the high flow regime. Based on this research, a washout bedform on the delta top can be achieved with a Froude number of approximately 0.55. The resulting high sediment transport during these conditions could generate mass wasting events and turbidity currents on the delta slope.



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UNIVERSITY OF NEW BRUNSWICK

SCHOOL OF GRADUATE STUDIES

ORAL EXAMINATION

Danar Pratomo

IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

Ph.D. Candidate

Danar Guruh Pratomo

Graduate Academic Unit

Geodesy & Geomatics Engineering

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May 13, 2016

1:00 p.m.

Head Hall
Room E-11

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Examining Board:

Dr. John Hughes Clarke (Geodesy & Geomatics Eng.)	Supervisor
Dr. Ian Church (Geodesy & Geomatics Eng.)	
Dr. Susan Haigh (HRA, Geodesy & Geomatics Eng.)	
Dr. Katy Haralampides (Civil Engineering)	
Dr. John Kershaw (SGS)	Chairperson

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The Oral Examination will be chaired by:
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Universities attended (with dates & degrees obtained)

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Publications:

Hughes Clarke, J.E., Marques, C.R., **Pratomo, D.G.**, 2014, Imaging Active Mass-Wasting and Sediment Flows on a Fjord Delta, Squamish, British Columbia: in S. Krastel et al. (eds.), Submarine Mass Movements and Their Consequences, Advances in Natural and Technological Hazards Research, 37, p.249-260, DOI 10.1007/978-3-319-00972-8 22.

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Pratomo, D.G., Hughes Clarke, J. E., 2015, Understanding Sediment Flux Through Delta-top Channels Using Repetitive Multibeam and Hydrodynamic Modeling, American Geophysical Union Joint Assembly 2015, Montreal - Canada.

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